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ABSTRACT

The most promising and significant utilization of computer science in school districts is said to be in the domain of curricular decision making. The potential for humanizing instruction for students and refining the content and make-up of curricular offerings is particularly emphasized. A step-by-step decision making method is advanced as follows: identifying and sequencing skills and processes; referencing skills and processes to curricular materials; constructing representative test items; referencing test items to skills and processes; and establishing decision rules. Methods for improving more effective delivery of services to students are described, along with the use of computers in curricular material organization and cost-effectiveness analysis. (SK)

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CRITERION-REFERENCED CURRICULAR DECISION-MAKING

Critical Computer Applications

BY

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The track record of curriculum personnel in harnessing the speed and versatility of the computer for curriculum decision-making purposes has been most unimpressive. And there should be little wonder about this. In the early years of computer installation in school systems, it was the business-oriented educator who perceived the promise and opportunity that computer technology held for processing data in innumerable versions and combinations to enhance fiscal decision-making and accountability. Curriculum leaders continued to be among the entrenched skeptics who believed that anything really worthwhile should be humanly processed with a careful measure of reflectiveness and, most undubitably, should not be left to the clumsy machinations of an awkward combination of integrated circuits controlled by an unimaginative computer programmer, who most frequently spoke in a foreign language of bits, bytes, core, disk, mod, and other unintelligible verbiage. So the world of the curriculum educator progressed in the age of computer technology, and even today, most school district instructional leaders having access to the computer degrade its magnificent processing capacities to the level of a class III clerk typist. In this light, there should be little wonder that the priority rating of most instructional applications in all but a few school districts falls only slightly behind the production of the Expenditure Report on Janitorial Supply Utilization.

Fortunately for us curriculum people, a small but increasing number of instruction-minded educators are now envisioning the dynamics of computer technology and are wresting control of a valuable aid - lost by default - that will furnish the key to critical curriculum decision-making in the public schools. Now that the retainer walls have given away, it would appear that an endless flood of "new" curriculum and instruction questions of crucial significance to the operation of school districts are being raised. Among them are "Can the computer be of assistance in sequencing instructional skills and processes taught in the classroom? Can it help in organizing curricular materials and rating them for classroom usage? In what manner can it assist in more accurate student diagnosis,

placement, prescription, assessment, supplementation, grouping, and monitoring? Can it help to specify inservice training needs?" The number and quality of the questions are heartening. Curriculum people are arriving, finally. At the same time, however, they are not infrequently finding that the present degree of curricular specification is not sufficient to enable the computer to provide meaningful, usable information that can be applied to sound curricular decision-making.

The first order of business, it would appear, is for curriculum leaders and designers to prepare themselves for the demanding data requirements requisite to complex curricular decision-making. When this is at a sufficiently accomplished state, the computer will provide analytic responses with the sophistication desired to dramatically improve instructional services for students, teachers, and administrative decision-makers.

Preparation for Curricular Decision-Making

Making effective curricular decisions through the application of a computer requires thoughtful planning to identify the priority areas of a school district's informational needs, the scope of those needs, and the practical and potential utility of information that is gathered or generated. A curricular specification effort will surely follow this planning and will be directly dependent upon these factors. It is an axiomatic reminder that the computer can not and will not respond to questions which have not been asked, and its analytic responses will rarely be more sophisticated and have greater utility than that which was originally perceived by the inquirer.

Several of the most critical areas where the computer can be applied to curricular decision-making are (1) test generation, (2) student diagnosis, (3) student placement, (4) student grouping, (5) student prescription, (6) student monitoring, (7) skill and process sequencing, (8) curricular material organization, (9) select curricular material usage, (10) curricular material revision, (11) identification of inservice training needs for staff, (12) achievement gain parameters, (13) cost/effective analysis, and (14) curricular material ware-

housing and deployment. In most school systems, a few of these functions are being performed. Yet, all of them can be effectively accomplished in school systems with or without the use of a computer, though the rapidity of processing and the potential combination of analyses are unquestionably enhanced by computer availability.

The degree of curricular specification required to enhance decision-making in each of these fourteen areas is not nearly as prodigious and time-consuming as one might initially imagine. At the same time, it is noteworthy that the required specifications are so basic to the operation of curricular and instruction programs that they should have been accomplished in all school districts whether or not there is an interest in addressing any of the suggested strategical decision-making areas. Minimal specification activities to prepare for computer-applied curriculum decision-making are (1) the identification and sequencing of instructional skills and processes, (2) the referencing of identified instructional skills and processes to available curricular materials in the school district, (3) the construction of representative test items for each instructional skill and process, (4) the referencing of developed test items to each instructional skill and process, and (5) the establishment of a series of decision rules that will be applied to data generated by the computer.[1] Unquestionably, there are an excessive number of additional, more detailed curricular specifications that can be undertaken to improve school district curricular content, delivery, and assessment, but it would appear prudent to obtain, initially, the wealth of curricular decision-making information that can be derived with a modest time and cost input. With that successful experience realized, the need for and desirability of forging ahead in more detailed areas of curricular investigation and specification become readily apparent.

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[1]Detailed examination of these and additional specifications for curricular decision-making are found in Roger B. Worner's, Criterion-Referenced Diagnosis, Placement, and Prescription (Nashville, Tennessee: Learn, Inc., 1975).

Identifying and Sequencing Skills and Processes. Primary to curriculum and instruction decision-making of any type is that school districts clearly specify the detailed foundations upon which their programs are based and the instructional elements that the programs convey to the student. Whether school districts label the instructional foundations for their programs as skills, processes, concepts, elements, principles, or a combination of these terms, it is vital that they be explicitly identified for each program, grade level, course, or subject. Furthermore, the instructional foundations will need to be sequenced in a manner that seemingly best represents a logical pattern for introducing and instructing these elements to students as they progress through a course, grade level, or program.

The process of identifying and sequencing skills and processes is not a particularly awesome task, though it is doubtlessly flawed because school district personnel have rarely attempted it before. At the same time, however, every textbook, workbook, and aid used in the schooling process has a stated sequence, and contrary to what many people will claim, most instructional staff members follow the publisher's sequence quite religiously. Thus, in the absence of any more sophisticated approaches, staff members selected to identify and sequence skills and processes can accomplish the process by replicating publisher skills and sequences or empirically deriving them.

Referencing Skills and Processes to Curricular Materials. A more time-consuming but no more difficult task to prepare for curricular decision-making is the referencing of instructional skills and processes to available textual, workbook, and aid materials frequently used by classroom teachers in conveying skills and processes to students. The process amounts to citing the title of a book (workbook or aid) and the page numbers where a particular instructional skill or process is treated. This task will need to be done for each skill and process in each program, grade level, course, or subject available in the school district or, if a lesser approach is selected, to those programs, grade levels, courses, or subjects on which the school

district wishes to gather and process decision-making data.

Obviously, the more extensively that skills and processes are referenced to a broad range of available school district curricular materials the greater will be the decision-making potential to school administrators and classroom teachers.

Constructing Representative Test Items. A task crucial to curricular decision-making is the construction of representative test items for each skill and process identified in each program, grade level, course, or subject. Since the test items will be used innumerable times in collecting deciding information, it would be advisable that test item writers be trained in the intricacies of performing this task. The process is not difficult to learn, and highly successful results can be achieved with a minimal amount of capable guidance.

School districts may wish to consider the development of several test items (perhaps as many as ten) for each skill and process to enhance the capability of generating multiple forms of tests with varied test items.

Referencing Test Items to Skills and Processes. Since test items are developed for explicit skills and processes previously identified, referencing the items is a simple clerical matter. In the process of carrying out the item to skill and process referencing, it is worth noting that because of the previous skill and process referencing to curricular material, the school district will have accomplished a test item to curricular material referencing without the need for actually undertaking that process.

Establishing Decision Rules. At some point in the conceptualization of each of the curricular decision-making areas, school district personnel will need to establish decision rules that govern how the computer should process, act upon, and report data. As an example, if placement tests for reading are generated and administered to first grade children, rules will need to be established governing how the computer should correct the test; indicate skill/process

proficiency, deficiency, or questionable mastery; establish a student's placement based on deficiency; document the type and number of potential instructional prescriptions that may be used for beginning or follow-up instruction; and report other information in a form and according to specifications desired by administrators and teachers.

The setting of decision rules is not a difficult process, and the only certain guidelines for setting them are that the user have confidence the rules will not distort the data in a manner which would cause questionable or faulty decision-making to occur. Thus, those who establish decision rules have the responsibility to assess the degree of stringency that will be applied to data. If decision rules are too stringent, they may over-discriminate; if they are too lax, they may under-discriminate. Under any condition, however, decision rules - like skills, processes, sequences, test items, referencing, and the curricula itself - are changeable, and a part of the rationale for undertaking these activities is to learn. As such, the setting of decision rules will need to be done with care, but the expectation that it will be done without error and revision is unrealistic.

Criterion-Referenced Curricular Decision-Making. Having completed the specification activities for curricular decision-making, school districts will have delineated criterion-referenced data, information that is built upon or reflective of actual local programs and procedures. The value of criterion-referenced data specification for decision-making is that it captures the essence of the content, sequence, and measurement criteria of local programs, while non-criterion-referenced data specification, at best, only approximates what "may be" the substance of local programs and, at worst, fails to reflect local programs at all. The obvious advantages of criterion-referenced data specification are that the data acquired have a direct bearing on the content, sequence, procedures, material, and measurement that are being employed in the school district, and the decision-making data collected cannot be dismissed or rationalized as irrelevant. Once that barrier

is removed, school administrators and teachers can look objectively and with confidence at gathered data and ferret out curricular areas which would appear to need attention. They can also proceed with a "controlled" adjustment of content, procedures, materials, and measurement variables - from a knowledgeable vantage point - in attempting to effect improved curricular programs.

Critical Computer Applications in the Curricula

The critical computer applications in the curricular area are those which effect the accurate and effective delivery of services to students. These applications revolve around the detection of a student's instructional status (test generation, student diagnosis, student placement, and student grouping); content delivery (student prescription and student monitoring); adjustment of curricular content and delivery (skill and process sequencing, curricular material organization, select curricular material usage, curricular material revision, identification of inservice training needs of staff, and curricular material warehousing and deployment); and broad-based, curricular decision-making (achievement gain parameters and cost/effectiveness analysis).

Test Generation. The prior specification of school district skills and processes and the development of test items referenced to those skills and processes enables curriculum personnel to use the computer in the generation of a multitude of different forms of criterion-referenced tests for diagnostic, placement, and assessment purposes. Depending upon the parameters established by school district personnel, tests can be constructed to diagnose or assess any phase of programming or student learning: multi-grade level, single grade level, multi-discipline, single discipline, skill strand, unit stand, and numerous others.

Student Diagnosis. Using tests generated on the skill and process content of a single or series of grade levels and applying decision rules reflecting the degree of a student's proficiency (e.g. mastery, non-mastery, questionable mastery), curriculum personnel can use computer technology to diagnose the location and

degree of student proficiency and deficiency.

Student Placement. Diagnostic information derived from criterion-referenced tests can be used to ascertain a student's instructional placement position in a program, grade level, course, or subject. By establishing and applying decision rules to the frequency, succession, or pattern of skill deficiency identified in criterion-referenced testing, the point at which a student's knowledge of the curricular program breaks down can be established, and the point of beginning instruction can be determined.

Student Grouping. Since school district personnel are able to acquire diagnostic and placement data on individual students using computer applications, they are also able to apply these individual datum to groups of students and determine the frequency, composition, and range of student deficiency for the purpose of initiating instructional groupings. Such a procedure can be applied on a classroom, grade level, program level, or school level basis depending upon the desires of school administrators and teachers.

Student Prescription. The referencing of test items to school district skills and processes, and, in turn, the referencing of the latter elements to curricular materials, permits curriculum and data processing personnel to construct computer applications that will yield information on student prescription. Each skill or process included in a curricular program is represented by one or a number of sets of instructional materials which can be used to convey the meaning and content of the skill or process. Depending upon the decision rules and parameters set up to report prescriptions, the computer can either report all (or some) identified prescriptions for the student's placement skill, the same information for all skills in which the student has exhibited deficiency prior to his placement position, or both types of information.

Student Monitoring. School districts can employ the computer as a periodic or continuous instructional monitoring device through on-line

or batch process modes. Monitoring can be used to ascertain student progress, reassess grouping patterns, affirm the presence or absence of proficiency or deficiency, test out the efficacy of prescriptions and original placement, and perform any number of administrative and teaching evaluations of curricular content delivery. It is noteworthy to mention that on-line processing and instantaneous teacher and student feedback, promoted by some as requisite for successful instructional activities, is most likely neither cost effective nor necessary if other curricular activities (e.g. skill and process identification and sequencing, curricular material specification, referencing, and criterion-referenced test construction) are properly and completely carried out.

Skill and Process Sequencing. School district personnel can obtain valuable information from the computer with which judgments about the appropriateness of instructional skill and process content and sequences may be tendered. Among other information yielded by computer-generated criterion-referenced tests are "deficiency counts" on each skill and process conveyed in the instructional program. Deficiency counts specify the incidence with which a given skill is answered incorrectly by students and states when there is no relationship between the incorrect answers and the student's final placement. If a skill's deficiency count is high - on a variety of different test items - it may suggest that the skill is inappropriately placed in the sequence or, it in some instances, is of questionable importance to the curricular program.

Curricular Material Organization. Just as the computer can be used to rearrange and extract skills and process from a curricular program because of their inappropriateness, it may be used in an identical manner to cause the rearrangement or deletion of curricular materials. Since curricular materials are referenced to instructional skills and processes during the curricular specification process, curricular materials may be resequenced by manual or machine reprogramming at the same time as each skill and process is being resequenced.

Select Curricular Material Usage. Perhaps among the more difficult tasks facing classroom teachers is selecting and employing curricular materials with children exhibiting forms of exceptionality (e.g. learning disability, emotional problems, educable mentally handicapped, blind, deaf and hard of hearing, and others). Because instructional centers for exceptional children are frequently scattered throughout a school district and the nature of the teaching task is inherently more difficult, teachers of the exceptional child require a greater degree of feedback on the instructional efficacy of curricular materials used with students having very unique learning problems. Such feedback may be obtained by recording the specific prescriptions employed with the district's exceptional children in mastery of skills or processes. The storage and processing of such data on a district-wide basis can be used to aid in strengthening the school district's curricular holding of select types of materials, preparing prescription profiles for exceptional students, projecting the characteristics of materials which have a high probability of success, deleting questionable materials, and mapping instructional strategies.

Curricular Material Revision. The computer is a valuable tool in assessing the points at which curricular materials are weak and in need of revision. By collecting feedback from teachers on prescriptions used in instructing specific skills and processes and assessing student criterion-referenced test results, evidence can be collected which suggest the need for a careful analysis and possible revision of curricular materials. Particularly is such analysis of value in assessing materials used to convey skills on which students frequently exhibit deficiency and which are likely to affect student placement.

Identification of Inservice Training Needs of Staff. Skills and processes that are frequently found deficient in post-criterion-referenced test assessment (after the student has received instruction) serve as a potential basis for curricular material revision, inservice training of staff, and, more likely, both. Again, the computer can serve as a data retriever and analyst

in determining the frequency and identity of vital, yet troublesome, skills and processes with which students exhibit a moderate or high degree of deficiency even after instruction has been carried out. Such information may be used to structure training sessions on methodologies, materials, and techniques for conveying skills and processes that are directly linked to student failure in the school district.

Curricular Material Warehousing and Deployment. Using end of the year diagnostic, placement, and prescriptive information gathered from computer-generated and processed criterion-referenced tests, a warehousing and deployment plan may be established and implemented to specify the exact quantity and type of district curricular materials delivered to each building and classroom in the school district. Such a plan insures that classroom teachers will have material resources readily at hand on the first day of school and that they will be specifically selected on the basis of each individual child's assessed needs. The classroom teacher may then apply diagnostic, placement, grouping, and prescription information on an individual or group basis immediately without experiencing the delays and errors that are characteristic of material deployment at the beginning of a school year.

Achievement Gain Parameters. School districts that have undertaken basic curricular specification will determine that the computer has unique capabilities for gathering and analyzing achievement data. For example, based on pre- and post-test administration of school district criterion-referenced tests, achievement gain data can be collected by school, program, grade level, department, or other organizational unit. Such information can be used to assess the priorities for funding, staffing, material allocation, and resource deployment to schools, programs, departments, and grade levels where unique learning problems appear to be causing underachievement. Flexible achievement gain parameters may be established - based on the past performances of school district students - to assess the present and project the future

efficacy of instructional programs in delivering appropriate services to students. Though such parameters will always be limited by the fact that the tested student clientele is forever changing, they have the inherent capability - when combined with other information - of identifying sources of curricular design or programming that are weak and require further study or immediate change.

Cost/Effectiveness Analysis. School districts employing a planning-programming-budgeting system framework for gathering and analyzing cost data are in a unique position to apply those data to achievement information gathered through curricular specification and derive cost/effectiveness comparisons among instructional programs. Using cost figures derived from a program budget and achievement gain figures acquired from the pre- and post-administration of criterion-referenced tests, cost/effectiveness ratios can be documented for similar programs, courses, and subjects. Determinations can then be made on the effect of cost increases, decreases, or stability on the variable effectiveness of diverse instructional practices, procedures, or support systems. School districts will find that cost/effectivness procedures are particularly valuable for assessing the relative merits and practices of alternative programs that are being considered for implementation, especially when cost is a vital consideration. Numerous other valuable insights are provided through the derivation of cost/effectiveness analysis. Among them are critical information for long-range planning, goal setting, priority setting, budget deliberation, innovative program design, and many others.

Conclusion

The practical applications to which the computer can be applied by school district personnel is virtually limitless. It would appear, however, that the most promising and significant utilization of computer technology in school districts may be in the domain of curricular decision-making. With a minimal amount of internal curricular specification -

involving the completion of tasks that are so basic to school district operation that they should have been completed decades ago - an entire panorama of improvement activities can be initiated to aid school districts in increasing the quality of curricular services they deliver to students. Perhaps the most significant aspect of computer utilization for the schools' cautious curriculum leaders to recognize is the potential that this tool holds for humanizing instruction for students and refining the content and make-up of curricular offerings. Without imposing any content or procedural limitations on school teachers and administrators, it can aid the schools in viewing the student in his fullest complexity and help to design an endless number of alternatives that can help him to achieve both personal and academic success in the schooling process.